

深圳维盛半导体科技有限公司

VS12L09A 参考手册

Evision Matrix LED Driver IC

1 PRODUCT OVERVIEW

1.1 FEATURES

- ◆ **Support I2C/SPI slave communication**
- ◆ **Built-in four LED Matrix Types**
 - ◆ **LED Matrix Type-1**
Achieve 9x8+9x8 LED matrix by CA1~CA9 and CB1~CB9.
Maximum to 144 LEDs are supported.
Maximum to 36 anode RGB LEDs are supported.
Maximum to 36 cathode RGB LEDs are supported.
 - ◆ **LED Matrix Type-2**
Achieve 12x12 LED matrix by CA1~CA9 and CB1~CB4.
Maximum to 144 LEDs are supported.
Maximum to 40 anode RGB LEDs are supported.
Maximum to 41 cathode RGB LEDs are supported.
 - ◆ **LED Matrix Type-3**
Achieve 16x16 LED matrix by CA1~CA9 and CB1~CB8
Maximum to 256 LEDs are supported.
Maximum to 75 anode RGB LEDs are supported.
Maximum to 75 cathode RGB LEDs are supported.
 - ◆ **LED Matrix Type-4**
Achieve conventional COM x SEG (12x12) LED matrix by CA1~CA9, CB1~CB9, and CC1~CC6.
Maximum to 144 LEDs are supported.
Maximum to 48 anode RGB LEDs are supported.
Maximum to 48 cathode RGB LEDs are supported.
- ◆ **LED Controls**
Each LED has the on/off control.
Each LED has the blink enable/disable control.
Each LED has the 8-bit programmable PWM duty.
Each LED has the open/short detection status.
Each LED has the anti-forward control (Vaf) to prevent the ghost LED effects.
Each LED has the +/-6% current fine tune control.
Support global 8mA~40mA constant current source control.
- ◆ **MPWM IO (CA1~CA9, CB1~CB9, and CC1~CC6)**
Each MPWM IO has sink current of 320mA.
Each MPWM IO supports staggered delay.
Each MPWM IO supports slew rate control.
Each MPWM IO except CC1~CC6 has the precise current skew under +/-2%.
Current skew between chips is under +/-2%.
- ◆ **System Clock Synchronization for cascaded LED drivers**
Support SYNC output in master mode.
Support SYNC input in slave mode.
- ◆ **I2C Slave**
Maximum to 400KHz
Support four auto-selective slave addresses by which AD pin is connected to. (VDD/VSS/SCL/SDA)
- ◆ **SPI Slave**
Maximum to 2.4MHz
- ◆ **Matrix Control Engine**
Support Type 1~4 matrixes by register setting.
The frame time depending on Matrix Type has different phase number.
Type-1 has the frame time 1098us including 9 phases.
Type-2 and Type-4 have the frame time 1464us including 12 phases.
Type-3 has the frame time 1952us including 16 phases.
Each phase includes the PWM duty time 107us and the blanking time 15us.
Support auto-breath control.
Support auto-blink control.
Support Audio-IN synchronous to auto-brightness control.
- ◆ **Audio In Gain Control**
Support register configurable gain for Audio-IN: 0dB, 3dB, 6dB, 9dB, 12dB, 15dB, 18dB, and 21dB.
Support auto-gain control.
- ◆ **Thermal Detection**
Support thermal shutdown at 150°C
Support thermal flag at 70°C
- ◆ **Power Modes**
Normal Mode
Software power down mode
Hardware power down mode.
- ◆ **Package**
QFN28/SSOP28.

1.2 PIN ASSIGNMENT

(SSOP 28pins): I2C Interface

CA9	1	U	28	CA8
VDD	2		27	CA7
SDB	3		26	CA6
SYNC	4		25	CA5
GND	5		24	CA4
R_EXT	6		23	CA3
CB1	7		22	CA2
CB2	8		21	CA1
CB3	9		20	SCL
CB4	10		19	SDA
CB5	11		18	AD
CB6	12		17	AGCIN
CB7	13		16	C_FILT
CB8	14		15	CB9

1.3 PIN DESCRIPTIONS

PIN NAME	TYPE	DESCRIPTION
VDD, VSS	P	Power supply input pin for digital and analog circuit. Power supply input pin for digital and analog circuit. Power supply input pins for digital and analog circuit.
MSEL	I	Mode selection pin for I2C or SPI interface. Input only pin. MSEL = 0 : I2C, pMSEL = 1 : SPI.
SDB	I	Schmitt trigger structure as input mode with internal pull-down resistor. Shutdown the chip when pull to low.
SYNC	I/O	Clock synchronous input or output pin. Schmitt trigger structure as input mode.
R_EXT/CS	I	R_EXT: Input only with internal pull down resistor in I2C mode. No external pull-down resistor is required. CS: Slave chip select input pin in SPI mode. Low active. Schmitt trigger structure as input mode.
C_FILT	O	Used for filter audio-in noise.
AGCIN	I	Audio-IN Input.
AD/MISO	I/O	AD: I2C slave address selection pin. Schmitt trigger structure as input mode. MISO: SPI Master-Input-Slave-Output pin.
SDA/MOSI	I/O	SDA: I2C compatible serial data pin. Open drain IO. Schmitt trigger structure as input mode. MOSI: SPI Master-Output-Slave-Input pin. Schmitt trigger structure as input mode.
SCL/SCK	I/O	SCL: I2C compatible serial clock pin. Open drain IO. Schmitt trigger structure as input mode. SCK: SPI Clock input pin. Schmitt trigger structure as input mode.
CA1~CA9	O	PWM IO with sink 320mA and constant current source.
CB1~CB9	O	PWM IO with sink 320mA and constant current source.
CC1~CC6	O	PWM IO with sink 320mA.

2 ARCHITECTURE DESCRIPTOR

2.1 RAM MAPPING FOR MATRIX TYPE 1 & 2 & 4

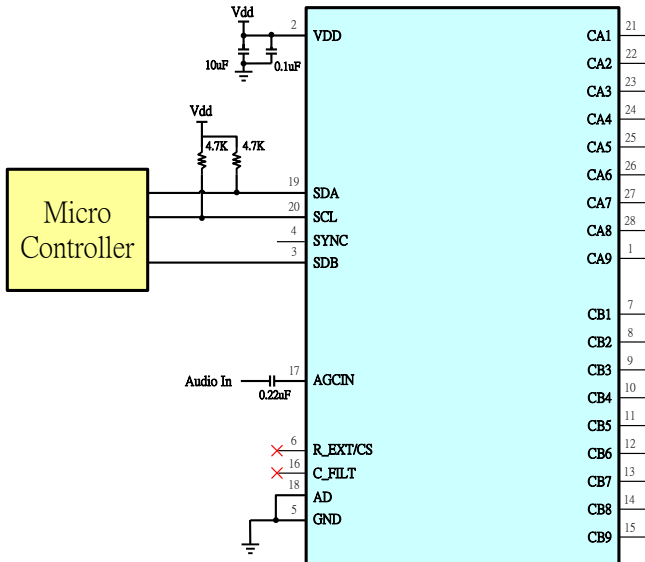
Frame No.	User Address	Register Segment	Comment
Frame 1	↑ 000H ... 011H	LED Control Register	18-byte
	012H ... 023H	Blink Control Register	18-byte
	024H ... 0B3H	PWM Register	144-byte
	↓		
	↑		
Frame C	000H ... 011H	LED Open Register	18-byte
	012H ... 023H	LED Short Register	18-byte
	024H ... 06BH	Current Fine Tune Register	72-byte
	↓		
	↑		
Frame D	000H ... 023H	LED Vaf Register	36-byte
	↓		

2.2 RAM MAPPING FOR MATRIX TYPE 3

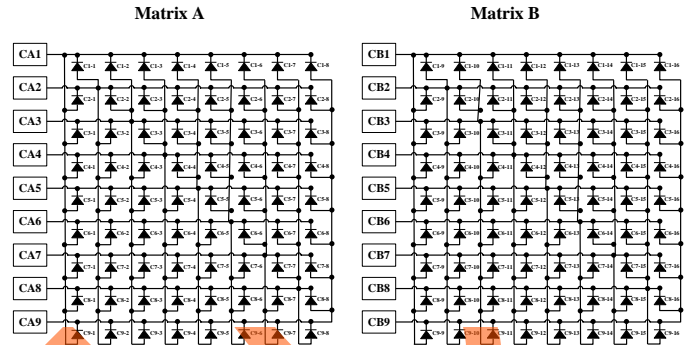
Frame No.	User Address	Register Segment	Comment
Frame 1	↑ 000H	LED Control Register L	16-byte
	...		
	00FH		
	010H	Blink Control Register L	16-byte
	...		
	01FH		
Frame 2	020H	PWM Register L	128-byte
	...		
	09FH		
	↑ 000H	LED Control Register H	16-byte
	...		
	00FH		
Frame 2	010H	Blink Control Register H	16-byte
	...		
	01FH		
	020H	PWM Register H	128-byte
	...		
	09FH		
Frame C	↓ 000H	LED Open Register	32-byte
	...		
	01FH		
	020H	LED Short Register	32-byte
	...		
	03FH		
Frame D	040H	Current Fine Tune Register	128-byte
	...		
	0BFH		
	↑ 000H	LED Vaf Register	64-byte
	...		
	03FH		

3 APPLICATION CIRCUIT

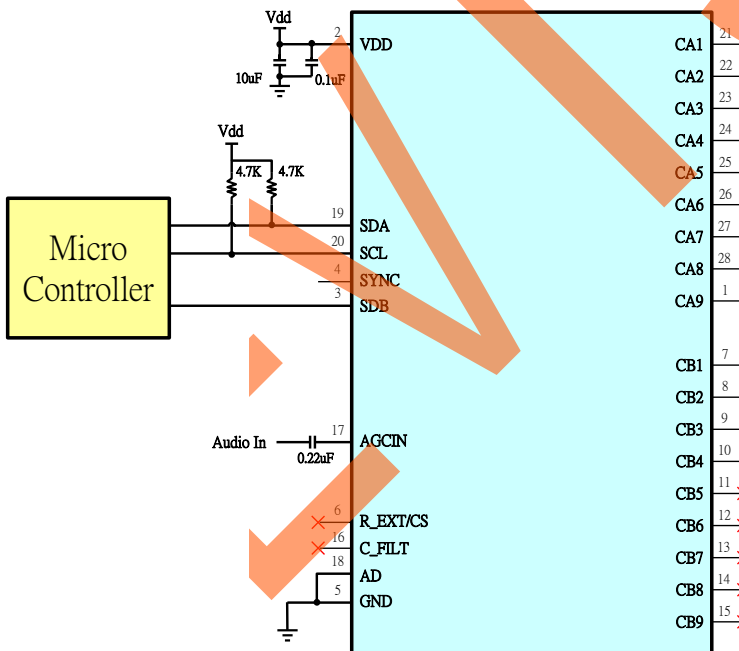
3.1 I2C INTERFACE WITH LED MATRIX TYPE-1



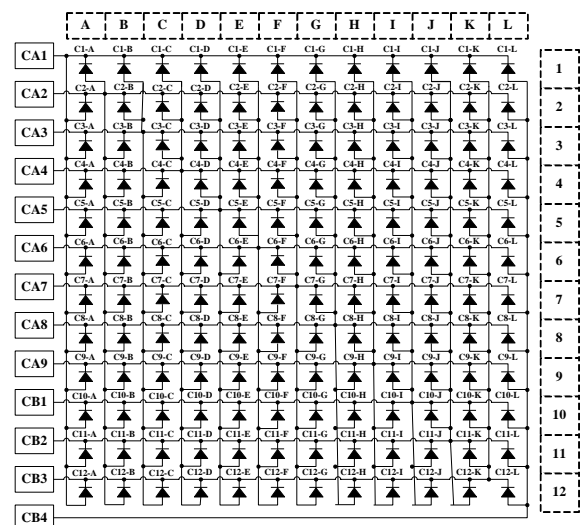
Matrix Type-1



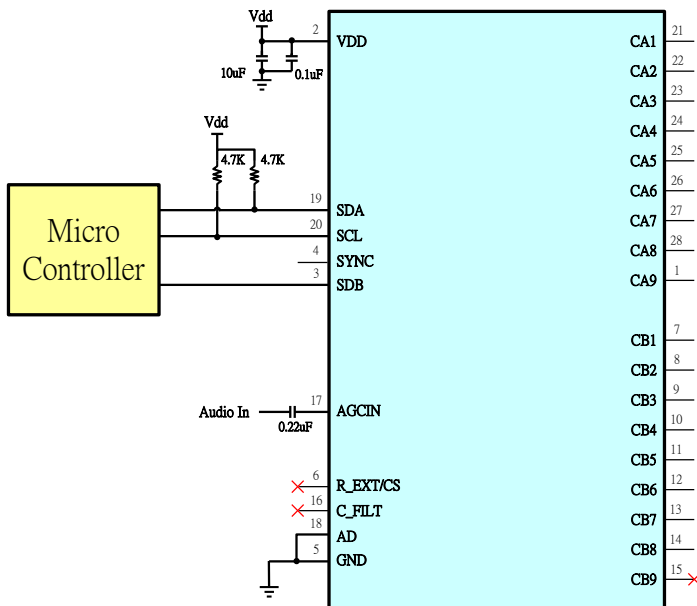
3.2 I2C INTERFACE WITH LED MATRIX TYPE-2



Matrix Type-2



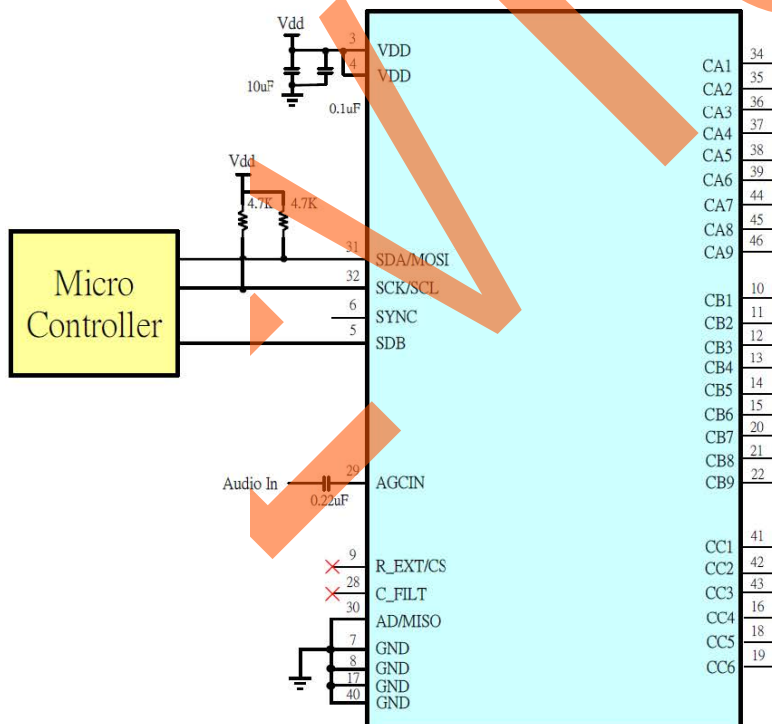
3.3 I2C INTERFACE WITH LED MATRIX TYPE-3



Matrix Type-3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
CA1	C1-A	C1-B	C1-C	C1-D	C1-E	C1-F	C1-G	C1-H	C1-I	C1-J	C1-K	C1-L	C1-M	C1-N	C1-O	C1-P	1
CA2	C2-A	C2-B	C2-C	C2-D	C2-E	C2-F	C2-G	C2-H	C2-I	C2-J	C2-K	C2-L	C2-M	C2-N	C2-O	C2-P	2
CA3	C3-A	C3-B	C3-C	C3-D	C3-E	C3-F	C3-G	C3-H	C3-I	C3-J	C3-K	C3-L	C3-M	C3-N	C3-O	C3-P	3
CA4	C4-A	C4-B	C4-C	C4-D	C4-E	C4-F	C4-G	C4-H	C4-I	C4-J	C4-K	C4-L	C4-M	C4-N	C4-O	C4-P	4
CA5	C5-A	C5-B	C5-C	C5-D	C5-E	C5-F	C5-G	C5-H	C5-I	C5-J	C5-K	C5-L	C5-M	C5-N	C5-O	C5-P	5
CA6	C6-A	C6-B	C6-C	C6-D	C6-E	C6-F	C6-G	C6-H	C6-I	C6-J	C6-K	C6-L	C6-M	C6-N	C6-O	C6-P	6
CA7	C7-A	C7-B	C7-C	C7-D	C7-E	C7-F	C7-G	C7-H	C7-I	C7-J	C7-K	C7-L	C7-M	C7-N	C7-O	C7-P	7
CA8	C8-A	C8-B	C8-C	C8-D	C8-E	C8-F	C8-G	C8-H	C8-I	C8-J	C8-K	C8-L	C8-M	C8-N	C8-O	C8-P	8
CA9	C9-A	C9-B	C9-C	C9-D	C9-E	C9-F	C9-G	C9-H	C9-I	C9-J	C9-K	C9-L	C9-M	C9-N	C9-O	C9-P	9
CB1	C10-A	C10-B	C10-C	C10-D	C10-E	C10-F	C10-G	C10-H	C10-I	C10-J	C10-K	C10-L	C10-M	C10-N	C10-O	C10-P	10
CB2	C11-A	C11-B	C11-C	C11-D	C11-E	C11-F	C11-G	C11-H	C11-I	C11-J	C11-K	C11-L	C11-M	C11-N	C11-O	C11-P	11
CB3	C12-A	C12-B	C12-C	C12-D	C12-E	C12-F	C12-G	C12-H	C12-I	C12-J	C12-K	C12-L	C12-M	C12-N	C12-O	C12-P	12
CB4	C13-A	C13-B	C13-C	C13-D	C13-E	C13-F	C13-G	C13-H	C13-I	C13-J	C13-K	C13-L	C13-M	C13-N	C13-O	C13-P	13
CB5	C14-A	C14-B	C14-C	C14-D	C14-E	C14-F	C14-G	C14-H	C14-I	C14-J	C14-K	C14-L	C14-M	C14-N	C14-O	C14-P	14
CB6	C15-A	C15-B	C15-C	C15-D	C15-E	C15-F	C15-G	C15-H	C15-I	C15-J	C15-K	C15-L	C15-M	C15-N	C15-O	C15-P	15
CB7	C16-A	C16-B	C16-C	C16-D	C16-E	C16-F	C16-G	C16-H	C16-I	C16-J	C16-K	C16-L	C16-M	C16-N	C16-O	C16-P	16
CB8																	

3.4 I2C INTERFACE WITH LED MATRIX TYPE-4



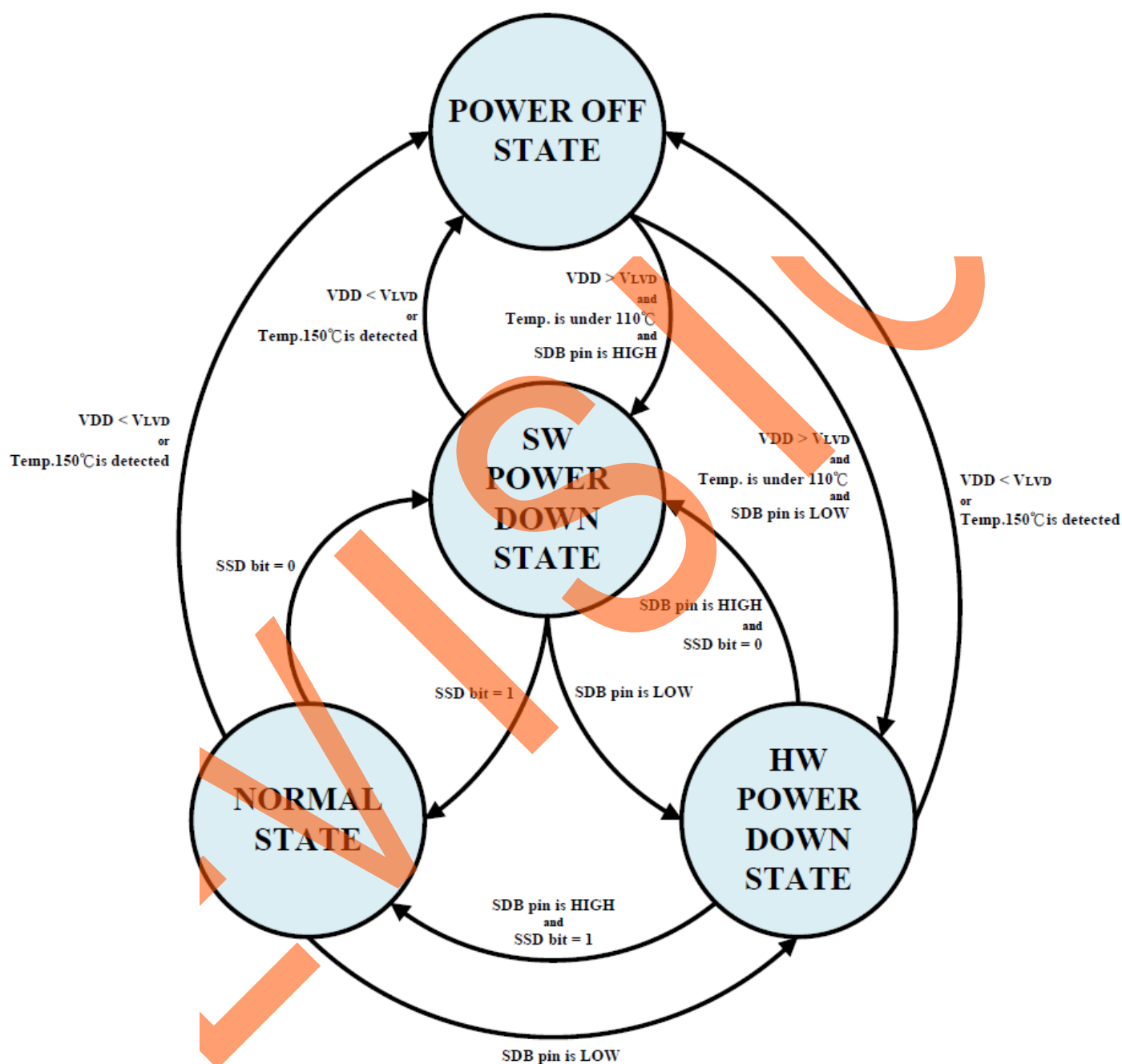
Matrix Type-4

	1	2	3	4	5	6	7	8	9	10	11	12	
CA1	G1-A	G1-B	G1-C	G1-D	G1-E	G1-F	G1-G	G1-H	G1-I	G1-J	G1-K	G1-L	A
CA2	G2-A	G2-B	G2-C	G2-D	G2-E	G2-F	G2-G	G2-H	G2-I	G2-J	G2-K	G2-L	B
CA3	G3-A	G3-B	G3-C	G3-D	G3-E	G3-F	G3-G	G3-H	G3-I	G3-J	G3-K	G3-L	C
CA4	G4-A	G4-B	G4-C	G4-D	G4-E	G4-F	G4-G	G4-H	G4-I	G4-J	G4-K	G4-L	D
CA5	G5-A	G5-B	G5-C	G5-D	G5-E	G5-F	G5-G	G5-H	G5-I	G5-J	G5-K	G5-L	E
CA6	G6-A	G6-B	G6-C	G6-D	G6-E	G6-F	G6-G	G6-H	G6-I	G6-J	G6-K	G6-L	F
CA7	G7-A	G7-B	G7-C	G7-D	G7-E	G7-F	G7-G	G7-H	G7-I	G7-J	G7-K	G7-L	G
CA8	G8-A	G8-B	G8-C	G8-D	G8-E	G8-F	G8-G	G8-H	G8-I	G8-J	G8-K	G8-L	H
CA9	G9-A	G9-B	G9-C	G9-D	G9-E	G9-F	G9-G	G9-H	G9-I	G9-J	G9-K	G9-L	I
CB1	G10-A	G10-B	G10-C	G10-D	G10-E	G10-F	G10-G	G10-H	G10-I	G10-J	G10-K	G10-L	J
CB2	G11-A	G11-B	G11-C	G11-D	G11-E	G11-F	G11-G	G11-H	G11-I	G11-J	G11-K	G11-L	K
CB3	G12-A	G12-B	G12-C	G12-D	G12-E	G12-F	G12-G	G12-H	G12-I	G12-J	G12-K	G12-L	L
	CB1	CB5	CB6	CB7	CB8	CB9	CC1	CC2	CC3	CC4	CC5	CC6	

4 SYSTEM OPERATION MODE

4.1 POWER STATE MACHINE FLOW CHART

Power states are determined by the VLVD threshold, the thermal detector 150°C threshold, the SDB pin state, and the software shutdown register (SSD bit) status.



5 ELECTRICAL CHARACTERISTICS

5.1 ABSOLUTE MAXIMUM RATING

Supply voltage (Vdd).....	- 0.3V ~ 5.5V
Input in voltage (Vin).....	Vss – 0.2V ~ Vdd + 0.2V
Operating ambient temperature (Topr).....	0°C ~ + 70°C
Storage ambient temperature (Tstor)	–40°C ~ + 125°C

5.2 ELECTRICAL CHARACTERISTIC

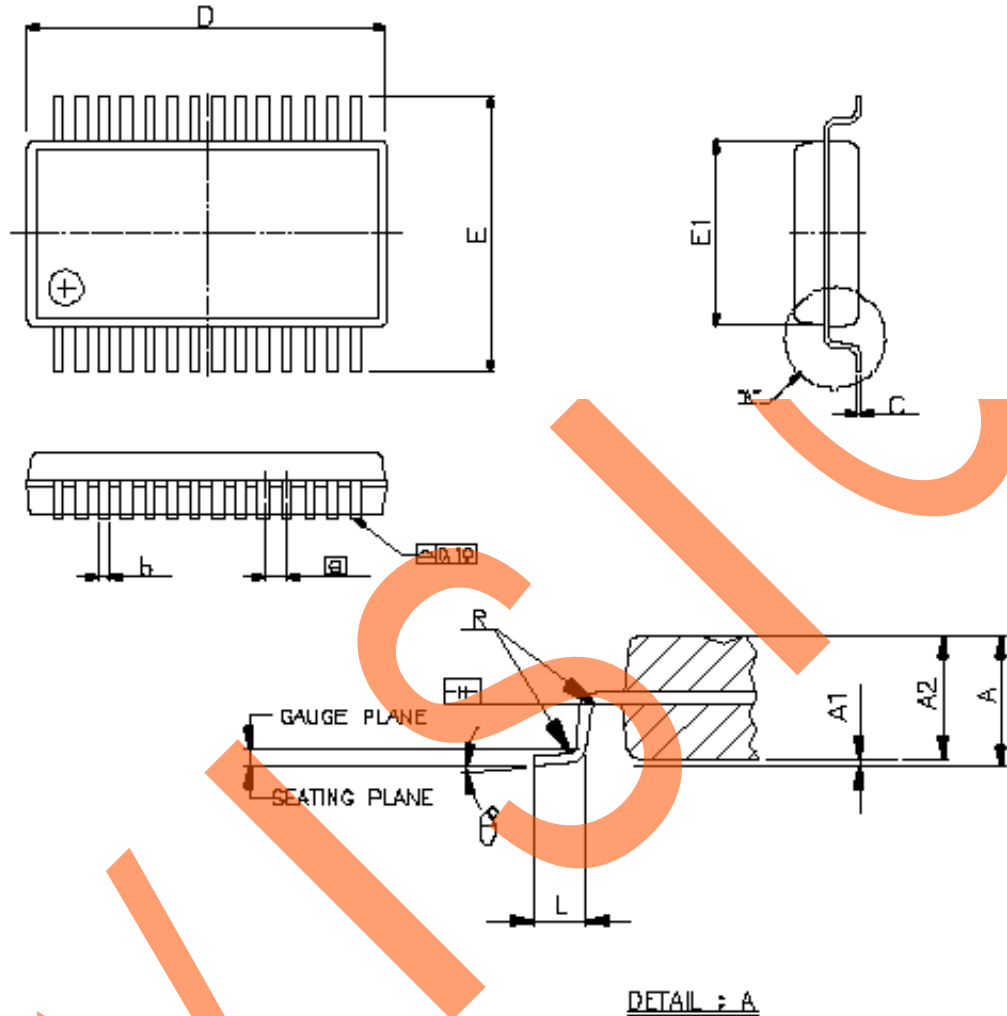
● DC CHARACTERISTIC

(All of voltages refer to Vss, Vdd = 5.0V,, ambient temperature is 25°C unless otherwise

PARAMETER	SYM.	DESCRIPTION	MIN.	TYP.	MAX.	UNIT
Operating voltage	Vdd		2.7	-	5.5	V
Vdd rise rate	Vpor	Vdd rise rate to ensure internal power-on reset	0.05	-	-	V/ms
Input Low Voltage	ViL	MSEL, SDB, SYNC, R_EXT/CS, SCK/SCL, SDA/MOSI, AD/MISO pins	Vss	-	0.3*Vdd	V
Input High Voltage	ViH		0.7*Vdd	-	Vdd	V
I/O port input leakage current	Ilekg	Vin = Vdd	-	-	2	uA
Default output current	Iout	Output current of CA1~CA9, CB1~CB9 The Constant Current Step setting is 11 0001b	-	32	-	mA
Current sink headroom voltage	VHR1	Isink = 270mA	-	-	400	mV
Current source headroom voltage	VHR1	Isource = 32mA	-	-	400	mV
I/O output source current sink current	IoH	Vop = Vdd – 0.5V			-	mA
	IoL	Vop = Vss + 0.5V			-	
Supply Current (Disable ADC)	Idd1	Normal Mode	Vdd= 5V	-	TBD	mA
	Idd2	Soft Shutdown Mode	Vdd= 5V	-	TBD	uA
	Idd3	Hardware Shutdown Mode	Vdd= 5V	-	TBD	uA
LVD Voltage	VLVD	Low voltage reset/indicator level	2.4	2.55	2.7	V

6 PACKAGE INFORMATION

6.1 SSOP 28 PIN



SYMBOLS	MIN	NOR	MAX	MIN	NOR	MAX
	(inch)			(mm)		
A	-	-	0.08	-	-	2.13
A1	0.00	-	0.01	0.05	-	0.25
A2	0.06	0.07	0.07	1.63	1.75	1.88
b	0.01	-	0.01	0.22	-	0.38
C	0.00	-	0.01	0.09	-	0.20
D	0.39	0.40	0.41	9.90	10.20	10.50
E	0.29	0.31	0.32	7.40	7.80	8.20
E1	0.20	0.21	0.22	5.00	5.30	5.60
[e]	0.0259BSC			0.65BSC		
L	0.02	0.04	0.04	0.63	0.90	1.03
R	0.00	-	-	0.09	-	-
θ°	0°	4°	8°	0°	4°	8°